High Performance Magentas for NIP-Applications

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Abstract

In the past the phrase high performance magenta colorants/pigments was only understood in terms of technical properties. A clear definition still doesn't exist. Since digital color presses and color laser printers have become a success story, cost relevant parameters like price and color strength of the colorant are and will be discussed more intensively. Compared to the trichromatic print colors cyan and yellow and especially for magenta, the discrepancy between the cost and technical performance level is more noticeable. The paper will describe the term high performance magenta including cost-related issues by the example of three typical magenta pigments for toner applications.

Introduction

Non-Impact Printing (NIP) has succeeded both for office as well as for production applications worldwide. Recent trends are "Hybrid Systems" which combine NIP technologies with conventional master-based printing systems, e.g. offset printing, in order to use the technology strength of both technologies. A first concept study was presented recently by Heidelberger Druck at DRUPA 2000.

Especially for production applications, electro-photographic-based systems have been launched by Xeikon, Nexpress, Indigo, etc. These systems are dominating that market since the first machines (Xeikon, Indigo) were introduced at IPEX fair/UK in 1993.

The basic colorants for electrophotographic digital printing inks /toners (electronic ink) belong to the colorant group of organic pigments (figure 1). For full color printing, the trichromatic colors yellow, magenta, cyan (YMC) are mainly used. In addition, black is added in order to generate a "real" black impression (YMCK). Furthermore, 6-color based color systems like Pantone^{R} colors are in discussion. The target is to expand the printable color gamut in order to improve the entire print quality.

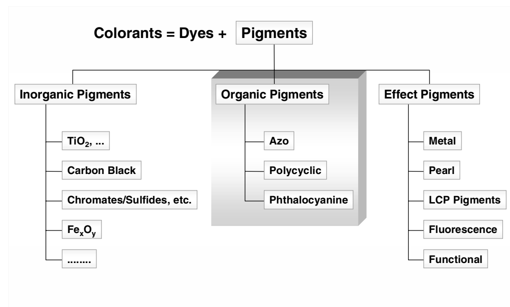

Figure 1. General idealized classification of the term pigment

In addition, so-called "spot colors" are becoming more and more popular e.g. for printing of distinct company colors. In that case a great many color shades/pigments have to be taken into consideration additionally. The paper will be concentrating on the color magenta by describing what could be understood by the term "high performance".

Selection of Magenta Pigments

As described previously[1] thousands of color pigment systems are known and many are commercially available. How does one select the useful ones?

Figure 2 shows a kind of "pigment map" which divides the whole range of existing organic color pigments in two major groups: 1. Azo-pigments and 2. Polycyclic/ phthalocyanine pigments. Each group is again divided into different pigment classes according to the basic chemistry e.g. quinacridones, benzimidazolones, etc. By selecting a distinct color shade e.g. magenta, only a limited number of chemical classes are applicable.

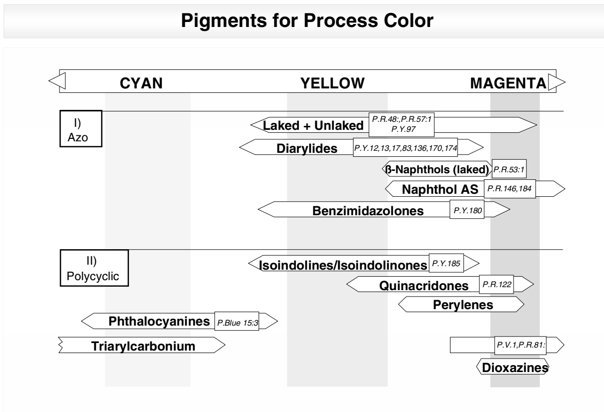

Figure 2. Classification of pigments in azo and polycyclic pigments including relevant chemical classes for process colors[2] marked according the shades cyan, yellow and magenta

Besides shade the second major selection parameter is the so-called triboelectric influence by the pigment in the toner. Figure 3 shows the well-known triboelectric spectrum of different colorant classes. Only selected pigment classes or pigment types out of a class are useful. In general, the colorants at the positive/negative end are also well-known as standard colored CCAs!

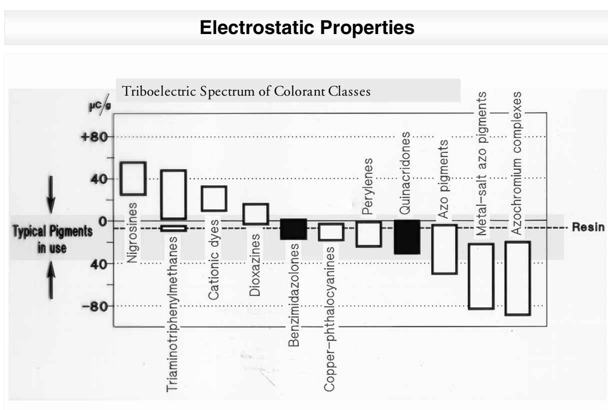

Figure 3. Triboelectric spectrum of different colorant classes

However, by applying both selection parameters: 1. the color shade and 2. electrostatic properties these two selection criteria drastically reduce the number of applicable pigments. Consequently, today the number of possible choices for magenta pigments, according to Colour Index[3] is concentrated on the following organic magenta colorants: P.R. 122, P.R. 57:1, P.R. 146, P.R. 184, P.R. 48:2, P.V. 19.

Recent developments in toner technology, like polymerization toner might create new restriction parameters for organic color pigments. For conventional blend/dry toners the starting material is a solid-solid mixture of the polymer + pigment/pigment masterbatch + further ingredients. The final dispersion of the pigment (goes parallel with deagglomeration of the pigment) is established during the manufacturing process.

For chemical toners typically a solid-liquid predispersion step has to occur in order to deagglomerate the coarse pigment particles. Such solid-liquid dispersion or suspension demands additional requirements on the pigment system. Now technical parameters like dispersion stability, viscosity influence and chemical reactivity have to be taken into consideration.

What is High Performance

In NIP applications there is no official definition of distinct parameters for the pigment/colorant. Common understanding associates performance with technical properties. What about costs? Since digital color presses first appeared on the market the cost/performance element for a colorant has become much more under focus. For instance, the digital color press inks (toner) have to compete now against conventional printing inks which are typically cheaper.

The pigment costs are dominated by the price/kg (process/raw materials) as well as by the color strength (chemical constitution) of the pigment himself. Color strength could be understood as the needed quantity of a distinct pigment to reach a desired hue. The color strength could vary in a wide range depending on physical and chemical properties of the basic molecule/ pigment.

It is not surprising that between technical performance and cost performance a discrepancy could exist. Figure 4, with the example of three magentas, may illustrate the point:

C.I. No.	Chemical Class	Technical Performance [light fastness]	Cost Performance [price/ color strength]
P. R. 122	Quinacridone	+	-
P.R. 184	Naphthol	+/-	+/-
P.R. 269	Naphthol	+/-	+/-
P.R. 57:1	BONA	-	+

Rating Tendency: + higher +/- middle - lower

Figure 4. Idealized Performance Rating of selected pigments in toner use. Deviations for specific sales products in special applications are possible. No strict border exists

From the technical side fastness properties, especially light fastness, are of major interest. Degradation of a pigment under the influence of light especially UV, leads directly to an observable decrease of the print quality. Therefore, in most cases light fastness is the leading technical parameter. But also dispersion behavior, transparency, thermal and system stability play important roles.

However, compared to the color cyan which is dominated by phthalocyanines, figure 4 indicates that for magenta the discrepancy between fastness properties and cost issues is more drastic.

Consequently, besides the classical and technically high performance pigments, e.g. quinacridones, mid-performing magentas are becoming more and more popular. Examples are P.R 184 or P.R 269.

Magenta Toner Pigments

Figure 5 provides the classical technical performance properties for 3 magenta pigments which are also described in figure 4.

C.I. No.	Chemical Class	d_{50}-value [nm]	BET-Surface [m^2/g]	Light fastness	Tribo-Value [µC/g]
P.R. 122	Quinacridone	ca. 65	ca. 80	ca. 7	Ca. –23
P.R. 184	Naphthol	ca. 110	ca. 44	ca. 5-6	-8
P.R. 57:1	BONA	ca. 160	ca. 35	ca. 4	-15

Figure 5. Technical properties of three different magenta pigments[4]

All of them fulfill the technical requirements regarding toner application: shade and triboelectric influence. Light fastness decreases from quinacridones towards P.R.57:1.

It should be also mentioned that certain activities exist in order to improve light fastness of e.g. P.R.57: 1 types by adding for example traces of UV-stabilizers.

But even in improved products, the decision for a high performing magenta pigment will be finally a compromise between the technical and cost performance under the view of the target application.

The poster will provide a visualization of the discussed items.

Conclusions

High performance magenta pigments are those which fulfill the coloristic as well as triboelectric requirements of toner applications. High light fastness compared with moderate triboelectric influence are the technical key parameters. In addition, the market puts strong pressure on the pigment costs driven by new application markets like digital press prints. Therefore, within the term high performance which was mainly technically defined, costs have to be taken also into consideration. Especially in the case of magenta the discrepancy between technical and cost performance is significant.

References

1. R. Baur, H.-T. Macholdt, Organic Pigments for Digital Color Printing, IS+T, Hilton Head, SC, 1995.
2. W. Herbst, K.Hunger, Industrial Organic Pigments, VCH, Weinheim 2nd Edition, Weinheim, 1997
3. Pigments. Bradford/UK. The Colour Index describes and lists the different individual pigments in terms of running numbers. It is a living list which is frequently up-dated.
4. The pigments mentioned in the paper belong to Clariant`s sales range for NIP applications. The pigments could be used both for toner as well as ink jet application. In detail: P.R.122 is Toner Magenta E02; P.R. 184 is Permanent Rubine F6B and P.R. 57:1 is Toner Magenta 6B. In addition, in figure 4 P.R.269 is mentioned which refers to Toner Magenta F8B LP 2604.